ECONOMIC ANALYSIS OF FUTURE DREDGED MATERIAL DISPOSAL IN LONG ISLAND SOUND

FINAL

PROGRAMMATIC

ENVIRONMENTAL IMPACT STATEMENT

FOR THE

DISPOSAL OF DREDGED MATERIAL

IN THE

LONG ISLAND SOUND REGION

APPENDIX C

1982

US Army Corps
of Engineers
New England Division

APPENDIX C

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I. INTRODUCTION

This appendix, entitled Economic Analysis of Future Dredged Material Disposal in Long Island Sound is intended to provide a general framework for future analysis of the economic feasibility of specific disposal sites and methods. Common economic variables for different disposal methods are discussed, and where possible, average or representative unit costs for various methods are displayed. It must be emphasized, however, that conditions vary so significantly from one dredging site or disposal site to another that it is difficult to even rank different disposal alternatives by relative economic efficiency, in any meaningful manner. This task could be readily accomplished on a project by project basis with specific disposal sites identified.

The first three sections of this appendix attempt to define past, present, and future dredging needs in the Long Island Sound area. Although any projections of future quantities of dredged material are necessarily speculative, the ranges presented in Section IV should serve as a realistic estimate on which to base future planning of a range of disposal alternatives. Section V describes in general terms what the impacts of potential disposal methods on the Long Island Sound area would be on the economy of that region.

II. EXISTING PORT ACTIVITY ON LONG ISLAND SOUND

Projections of future dredging needs in the vicinity of Long Island Sound depend largely upon future trends in port activity. As is true of all major commercial ports in New England, the major imports of the larger commercial ports along the Sound, including Stamford Harbor, Norwalk Harbor, Bridgeport Harbor, the Housatonic River, New Haven Harbor, the Connecticut River (below Hartford), the Thames River, and New London Harbor, are petroleum products. Included in this category are: residual fuel oil for electrical generation and heating of large commercial buildings, schools, and apartment houses; distillate fuel oil, primarily for home heating; and gasoline for automotive use.

Over the most recent decade for which data is available trends in total volume shipped through Long Island Sound ports show a net decrease of 13,130,834 tons (16.8%), with volume peaking in 1973 and declining steadily through 1977 (see Table C-1). During that same period, the only individual ports which showed a net increase in total tonnage shipped were New London, Fall River, and Port Jefferson, while net decreases were experienced on the Housatonic River, Norwalk and Stamford Harbors, Port Chester Harbor, East Chester Creek, the Bronx River, West Chester Creek, Flushing Bay and Creek, the Harlem River, the East River, Manhasset Bay, and Hempstead Harbor. All others remained relatively stable in net tonnage shipped.

TABLE C-1

LONG ISLAND SOUND PORTS
HISTORICAL TRENDS IN TOTAL TONNAGE
(Short Tons)

	1977	1976	1975	1974	1973	1972	1971	1970	1969	1968
Fall River	5,285,473	4,739,073	4,834,393	5,122,188	4,625,362	4,300,619	3,970,302	4,333,530	4,261,327	3,541,631
Providence River & Harbor	8,624,315	8,578,297	8,266,295	8,856,218	10,236,062	9,200,386	8,762,293	9,872,267	10,153,951	9,471,235
New London	2,649,757	3,342,238	3,480,918	4,578,685	5,580,248	5,332,189	3,883,247	3,876,682	3,063,259	1,431,458
Thames River	654,827	634,514	838,565	1,186,054	1,343,145	1,216,969	934,757	677,133	707,215	788,328
Conn River (Below Htfd)	2,171,256	2,229,683	2,562,245	3,049,883	3,487,419	3,426,016	3,774,048	3,814,704	4,357,487	3,651,872
New Haven	11,119,383	11,069,899	11,432,920	12,054,957	13,709,265	13,162,493	11,854,626	11,629,990	10,182,573	11,297,138
Housatonic R.	396,430	429,042	455,473	611,684	796,521	821,839	874,456	764,061	1,017,116	1,061,620
Bridgeport	3,495,140	3,265,113	2,860,171	3,295,195	3,553,980	3,471,623	3,548,554	3,843,722	3,847,560	3,436,096
Norwalk	822,908	753,478	847,490	799,974	867,306	812,865	919,466	1,057,945	1,855,155	1,106,521
Stamford	783,243	775,638	846,148	989,766	1,002,384	1,080,615	1,086,747	1,020,289	1,060,088	937,967
Port Chester Harbor	295,687	259,757	289,248	318,537	406,620	499,096	500,702	410,966	468,530	473,114
Mamaroneck Harbor	823	16,109	--	4,361	5,281	11,815	13,239	10,531	12,919	15,966
Echo Harbor	4,185	21,369	20,157	39,919	56,896	59,640	65,025	70,220	89,640	104,934
E. Chester Creek	1,363,524	1,367,380	1,575,743	1,935,192	1,974,777	2,138,314	2,344,933	2,206,988	2,194,437	2,264,024
Bronx River	286,629	382,537	258,203	293,966	450,586	427,962	528,220	498,038	488,502	506,091
Westchester Creek	548,321	560,458	485,433	439,898	525,740	602,977	844,969	901,482	1,004,007	906,949
Flushing Bay and Creek	1,848,185	1,569,289	1,953,276	2,359,574	2,745,007	2,474,983	2,350,648	2,505,999	2,531,785	2,346,036
Harlem River	422,919	449,179	719,304	566,785	654,251	837,737	654,269	637,258	953,351	1,002,202
East River	17,449,698	18,083,927	16,110,727	18,122,834	24,831,417	22,606,904	22,948,876	25,427,277	25,296,618	25,446,839
Manhasset Bay	306,868	323,384	420,036	413,456	427,002	538,367	870,430	1,136,475	1,114,424	1,378,258
Hempstead Harbor	1,502,662	1,488,398	2,298,906	3,229,077	3,932,757	4,125,250	4,328,107	4,149,324	4,619,975	4,447,732
Glen Cove Creek	224,400	246,973	225,580	215,216	189,342	176,322	203,890	177,472	227,131	222,975
Huntington Harbor	225,019	217,360	242,122	--	--	--	--	--	--	--
Port Jefferson Harbor	4,484,081	4,409,221	4,346,392	4,464,031	4,048,518	5,488,186	4,249,598	4,333,343	2,798,941	2,256,118
Greenport Harbor	27,366	16,818	28,196	25,950	28,980	26,788	31,482	23,513	20,776	28,529
Total	64,993,099	65,229,134	65,397,941	72,973,400	85,478,836	82,841,259	79,542,884	83,379,245	92,326,753	78,123,933

Source: Part 1--Waterborne Commerce of the United States, U.S. Dept. of the Army, Corps of Engineers, 1968-1977

These overall trends become more meaningful when analyzed on a commodity by commodity basis. The major receipt at six of the eight commercial ports in Connecticut is residual fuel oil, the total volume of which has declined by approximately one million short tons since 1969. As Table C-2 indicates, shipments of residual peaked in 1973 at almost double the level of 1977. Individual ports experiencing a slight net decline in residual shipments were New London, the Connecticut River, New Haven Harbor, and Bridgeport Harbor with Stamford Harbor showing a more significant net decline. Those ports for which a net increase in residual shipments is witnessed, including the Thames River, the Housatonic River, and Norwalk Harbor, do so because of the widespread substitution of petroleum for coal. It must be recognized that in each of these ports, a net decline in residual has actually occurred since the time of that substitution.

Distillate fuel oil ranks second in quantity received by the majority of ports along Long Island Sound, and appears to be following a declining trend similar to that described for residual. Overall, Connecticut ports reduced their distillate shipments over the period 1969-1977, by approximately one million short tons as indicated by Table C-3. Slight increases in net tonnage shipped occurred at New London, the Thames River, and Norwalk, with a significant decrease recorded on the Connecticut River and Bridgeport, and slight decreases at New Haven and Stamford. Very little distillate has been shipped over the Housatonic River since 1969.

The third major commodity shipped over Long Island Sound, gasoline, has shown an overall net increase over the last decade of approximately one million short tons, peaking in the most recent year for which data is available, 1977. The significant increases in gasoline receipts recorded at New Haven, Bridgeport, and the Thames River have been somewhat offset by substantial decreases at New London, Norwalk, Stamford, and the Connecticut River (see Table C-4).

Three other major commodities shipped through Long Island Sound and considered major receipts at several Connecticut ports are: sand, gravel and crushed stone; chemicals and chemical products; and iron and steel scrap; shown in Tables C-5, C-6 and C-7, respectively. Imports of sand, gravel and crushed stone have declined over the last decade, a trend particularly prominent between 1969 and 1971. Although an overall net decline has been experienced at each individual port, growth and decline on a year to year basis has been very erratic.

Receipt of chemicals and chemical products has increased in Connecticut ports as a whole, largely due to greater quantities shipped through the Thames River and New London Harbor. Total tonnage of chemicals shipped through New Haven has remained relatively constant, as has a relatively insignificant quantity at Bridgeport Harbor.

TABLE C-2

LONG ISLAND SOUND PORTS
HISTORICAL TRENDS IN RESIDUAL FUEL OIL SHIPMENTS
(Short Tons)

	1977	1975	1973	1971	1969
Fall River	2,158,206	1,534,145	2,536,856	1,474,647	830,537
Providence River and Harbor	1,579,989	1,045,144	2,479,466	1,831,982	2,835,033
New London	2,064,689	3,073,449	5,050,598	3,446,576	2,547,276
Thames River	276,355	519,174	1,035,989	*557,777	*89,577
Conn. River (Below Htfd)	1,025,235	1,378,075	1,760,061	1,452,643	1,881,336
New Haven Harbor	2,751,965	3,192,545	4,552,342	3,515,780	2,901,966
Housatonic River	380,342	450,690	776,497	*375,845	*251,222
Bridgeport	1,251,082	1,180,036	1,562,502	1,694,022	1,659,501
Norwalk	573,186	543,542	600,281	*93,413	*1,787
Stamford	56,876	24,862	28,355	101,151	*64,694
Flushing Bay-Creek	302,423	299,627	288,540	308,827	309,803
Harlem River	281,087	257,143	92,031	230,023	337,679
East River	11,014,925	8,097,936	8,656,508	12,021,321	13,082,110
Port Chester	4,985	4,526	11,463	39,254	34,665
East Chester	62,902	38,396	46,417	70,645	59,992
Bronx River	--	--	--	--	2,698
West Chester Creek	23,921	10,498	2,649	23,466	157,836
Manhasset Bay	45,018	--	2,317	993	--
Hempstead Harbor	197,618	133,986	428,098	396,539	409,187
Port Jefferson	654,058	663,073	773,100	1,119,497	497,997
Echo Bay Harbor	--	--	--	--	--
Glen Cove Creek	--	--	2,094	--	--
Greenport Harbor	--	--	--	--	--
Huntington Harbor	--	--	--	--	--
Mamaroneck Harbor	--	--	--	--	--
Total	24,704,862	22,446,847	30,686,164	28,754,440	27,954,896

*Substantial quantity of coal imported

TABLE C-3

LONG ISLAND SOUND PORTS
HISTORICAL TRENDS IN DISTILLATE FUEL OIL SHIPMENTS
(Short Tons)

	1977	1975	1973	1971	1969
Fall River	1,398,021	1,177,087	606,820	726,304	1,554,832
Providence River and Harbor	2,360,905	2,488,068	2,359,332	2,771,512	3,188,815
New London	248,565	255,472	260,331	254,082	232,935
Thames River	158,462	133,621	178,097	171,684	123,325
Conn. River (Below Htfd)	356,113	352,382	442,495	755,329	819,972
New Haven	3,359,264	3,843,679	4,455,271	4,310,869	3,715,433
Housatonic R.	0	0	7,107	0	225
Bridgeport	595,086	549,126	579,596	634,933	804,136
Norwalk	196,086	190,046	180,996	179,938	152,129
Stamford	437,542	438,153	496,736	482,712	469,731
Flushing Bay and Creek	414,799	400,436	414,768	420,589	414,598
Harlem River	57,912	72,734	49,855	64,455	243,521
East River	2,194,321	2,763,750	8,112,374	3,266,497	2,067,030
Port Chester	159,306	149,837	159,347	173,333	186,974
East Chester	374,328	362,210	382,447	436,485	449,578
Bronx River	--	--	--	--	--
West Chester Creek	342,937	283,041	296,137	363,460	388,292
Manhasset Bay	259,246	271,972	338,268	432,500	446,185
Hempstead Harbor	231,691	266,340	265,168	296,350	291,131
Port Jefferson	1,801,617	1,689,571	1,429,727	1,608,479	1,016,812
Echo Bay Harbor	--	20,157	17,015	18,361	10,308
Glen Cove Creek	50,255	49,080	49,640	43,508	81,027
Greenport Harbor	10,999	9,280	8,597	11,843	6,526
Huntington Harbor	9,898	15,012	13,481	35,696	110,605
Mamaroneck Harbor	--	--	5,281	8,491	8,387
Total	15,467,349	15,781,072	21,168,886	17,467,410	16,782,501

Source: Part 1--Waterborne Commerce of the United States, U.S. Dept of the Army, Corps of Engineers, 1968-1977

TABLE C-4

LONG ISLAND SOUND PORTS
HISTORICAL TRENDS IN GASOLINE SHIPMENTS
(Short Tons)

	1977	1975	1973	1971	1969
Fall River	947,902	842,903	981,328	894,188	685,797
Providence River and Harbor	2,961,426	3,376,325	3,265,602	2,563,064	2,596,856
New London	6,612	0	1,390	0	13,428
Thames River	102,548	112,940	69,557	62,431	5,598
Conn. River (Below Htfd)	625,130	724,504	843,663	1,111,239	1,231,278
New Haven	3,540,700	3,023,486	2,805,029	2,354,180	1,895,234
Housatonic River	0	0	0	0	0
Bridgeport	1,012,163	793,820	919,611	803,593	848,267
Norwalk	9,789	9,968	3,198	15,723	11,018
Stamford	21,376	33,938	52,988	112,882	65,642
Flushing Bay and Creek	--	--	--	--	--
Harlem River	--	--	--	--	992
East River	226,572	154,170	115,694	90,728	154,629
Port Chester	36,734	17,539	48,358	83,882	97,218
East Chester	806,116	823,131	800,403	1,122,559	1,062,933
Bronx River	--	--	--	--	--
West Chester Creek	172,716	187,418	213,374	203,135	208,384
Manhasset Bay	2,604	29,689	55,447	138,857	171,105
Hempstead Harbor	227,315	445,089	512,777	640,025	552,002
Port Jefferson	1,623,801	1,463,656	1,246,708	875,883	665,917
Echo Bay Harbor	--	--	--	--	--
Glen Cove Creek	--	595	--	--	--
Greenport Harbor	13,384	16,067	17,733	14,407	10,719
Huntington Harbor	--	--	--	--	649
Mamaroneck Harbor	--	--	--	4,748	4,532
Total	12,336,888	12,055,238	11,952,860	11,091,524	10,282,198

TABLE C-5

LONG ISLAND SOUND PORTS
HISTORICAL TRENDS IN SAND, GRAVEL AND CRUSHED STONE SHIPMENTS
(Short Tons)

	1977	1975	1973	1971	1969
Fall River	--	--	--	--	--
Providence River and Harbor	--	--	--	--	--
New London	0	0	0	0	0
Thames River	0	0	0	0	0
Conn. River (Below Htfd)	0	0	0	0	0
New Haven	6,121	0	47,517	3,600	17,175
Housatonic River	16,088	4,783	12,917	54,900	7,489
Bridgeport	25,802	29,406	0	2,718	43,978
Norwalk	38,667	49,116	78,891	89,735	897,089
Stamford	205,308	283,682	290,454	301,455	325,767
Flushing Bay and Creek	540,385	654,938	1,419,128	1,221,091	1,233,947
Harlem River	83,920	352,315	477,796	312,570	289,201
East River	238,393	688,769	1,632,370	1,130,182	944,587
Port Chester	92,576	115,675	185,028	201,913	148,738
East Chester	116,850	312,581	686,438	637,151	535,880
Bronx River	191,340	180,580	355,074	434,735	378,856
West Chester Creek	8,747	4,320	--	211,983	204,529
Manhasset Bay	--	118,375	30,970	298,080	496,530
Hempstead Harbor	826,240	1,442,542	2,719,644	2,874,258	3,272,007
Port Jefferson	379,775	494,565	570,564	599,340	609,119
Echo Bay Harbor	4,185	--	39,881	46,664	79,332
Glen Cove Creek	166,945	173,963	132,058	153,572	140,579
Greenport Harbor	--	--	--	--	--
Huntington Harbor	214,826	226,827	458,031	246,338	221,103
Mamaroneck Harbor	823	--	--	--	--
Total	3,156,991	5,182,437	9,136,761	8,820,285	9,845,906

Source: Part 1--Waterborne Commerce of the United States, U.S. Dept of the Army, Corps of Engineers, 1968-1977

TABLE C-6

LONG ISLAND SOUND PORTS
HISTORICAL TRENDS IN CHEMICAL AND CHEMPRODUCT SHIPMENTS[1]
(Short Tons)

	1977	1975	1973	1971	1969
Fall River	7,849	--	--	--	--
Providence River and Harbor	10,489	--	--	10,940	475
New London	46,635	47,754	19,957	0	0
Thames River	113,600	69,096	0	45,874	48,781
Conn. River (Below Htfd)	0	0	0	0	0
New Haven	275,375	254,269	343,248	283,242	229,763
Housatonic River	0	0	0	0	0
Bridgeport	216	26	0	1,779	1,131
Norwalk	0	0	0	0	0
Stanford	0	0	0	0	0
Flushing Bay and Creek	--	--	--	--	--
Harlem River	--	--	--	--	--
East River	25,684	39,850	32,106	27,194	31,226
Port Chester	--	--	--	--	--
East Chester	--	--	--	--	--
Bronx River	--	--	--	--	--
West Chester Creek	--	--	--	--	--
Manhasset Bay	--	--	--	--	--
Hempstead Harbor	--	--	--	--	--
Port Jefferson	20	--	3	--	--
Echo Bay Harbor	--	--	--	--	--
Glen Cove Creek	--	--	--	--	--
Greenport Harbor	--	--	--	--	--
Huntington Harbor	--	--	--	--	--
Mamaroneck Harbor	--	--	--	--	--
Total	479,868	410,995	395,314	369,029	311,376

[1]Includes only amounts listed as "Basic Chemicals and Products, NEC". Additional chemicals are shipped through these ports under different classifications.

TABLE C-7

LONG ISLAND SOUND PORTS
HISTORICAL TRENDS IN IRON AND STEEL SCRAP SHIPMENTS
(Short Tons)

	1977	1975	1973	1971	1969
Fall River	--	--	--	--	--
Providence River and Harbor	389,527	292,725	408,536	222,868	169,776
New London	0	0	0	0	0
Thames River	0	0	0	0	0
Conn. River (Below Htfd)	0	0	7,793	9,583	3,404
New Haven	176,142	161,840	354,079	187,518	293,757
Housatonic River	0	0	0	0	0
Bridgeport	36,454	36,584	81,320	41,385	98,547
Norwalk	0	0	0	0	0
Stanford	40,069	53,772	75,424	65,154	66,684
Flushing Bay and Creek	--	--	--	--	--
Harlem River	--	--	--	--	--
East River	49,649	53,887	87,540	63,662	76,840
Port Chester	--	--	--	--	--
East Chester Creek	1,170	--	10,573	29,399	39,111
Bronx River	82,129	76,965	95,512	93,485	105,973
West Chester Creek	--	--	--	--	--
Manhasset Bay	--	--	--	--	--
Hempstead Harbor	--	--	--	--	--
Port Jefferson	--	--	--	--	--
Echo Bay Harbor	--	--	--	--	--
Glen Cove Creek	--	--	--	--	--
Greenport Harbor	--	--	--	--	--
Huntington Harbor	--	--	--	--	--
Mamaroneck Harbor	--	--	--	--	--
Total	775,140	675,773	1,110,320	713,054	854,092

Source: Part 1--Waterborne Commerce of the United States, U.S. Dept of the Army, Corps of Engineers, 1968-1977

Shipments of iron and steel scrap from Long Island Sound ports have decreased substantially since 1969, of particular significance at New Haven and Bridgeport Harbors. This decreasing trend is reportedly the result of poor domestic market conditions and the inability of American exporters to compete with foreign exporters in foreign markets, and not due to lack of supply or inadequate port conditions.

At the present time, no major container facilities have been developed in any of the major commercial ports on Long Island Sound.

In addition to the commercial activity described, recreational activity along the Sound has been increasing rapidly over recent decades. Powerboating, sailing, and fishing (for sport and profit) are prevalent along the entire shoreline of the Sound. Major recreational ports included in the Western Coastal Area of Connecticut are: Greenwich Harbor, the Mianus River, Westcott Cove, Fivemile River Harbor, Westport Harbor and the Saugatuck River, and Southport Harbor. The Central Coastal Area includes: Milford Harbor, Branford Harbor, Stony Creek Harbor, Guilford Harbor, Clinton Harbor, Duck Island Harbor, and the Patchogue River. The Eastern Coastal Area includes the following small boat ports: Niantic Bay, Mystic River, Stoningon Harbor, and the Pawcatuck River. Each of these harbors is used extensively during peak summer months and is currently subject to growth pressure. Most private and public yacht clubs and marinas throughout the Sound region are filled to capacity and report waiting lists for moorings and dock facilities.

III. PROJECTED FUTURE PORT ACTIVITY ON LONG ISLAND SOUND

The level and types of activity in the many commercial and recreational ports along Long Island Sound will influence the future need for dredging. At the present time, the economic viability of the major commercial ports in Connecticut is dependent upon the shipment of large volumes of petroleum products via barge and tanker, drawing up to 38 feet of water. In 1977, petroleum products accounted for approximately 77 percent of the total volume of shipment through all Long Island Sound ports, in both Connecticut and New York. Many of these ports, including Bridgeport, New Haven, and New London, are currently under consideration for navigation improvements through channel deepening and/or widening, addition of anchorage space, and/or the enlargement of maneuvering areas. Because the major commodity shipped through these ports is petroleum products, it is difficult to predict with any accuracy what the future level of activity will be in the context of existing political and institutional problems affecting supply. Also, it is not likely that imports of petroleum products at any New England ports will continue to increase at the rapid rate that was once anticipated due to a concerted effort on the part of the United States Government, private utilities, and consumers to conserve fuels and reduce dependence on foreign energy sources. Therefore, planning for all improvement proposals in the area is highly speculative because the commercial needs of the port are so uncertain.

Various projections of future import levels for petroleum products in New England ports, including those along Long Island Sound, are rapidly becoming available. The New England Division (NED) of the Corps of Engineers contracted with Resource Planning Associates of Cambridge, Massachusetts, to develop projections of major petroleum products through the year 1995 for specific ports. Individual commodity projections by port were developed through the following procedure:

1. Surveyed existing projections of energy consumption in New England and selected the most recent projections of the U.S. Dept. of Energy (DOE), published in August 1979. These projections show an increase in quantities of residual and distillate fuel oil through 1985, after which a decline in consumption would be anticipated through 1995. Projections for gasoline show a slight decline through 1985, followed by stable consumption through 1990 and a slight increase through 1995. The DOE projections are also broken down by sector utilization, i.e., residential, commercial, industrial, transportation, and electric utility, and were computed taking both regional factors and national trends into consideration. The sharpest decline evident was in the use of residual fuel oil by the electric utility sector.

2. Identified petroleum product flows throughout New England, i.e., flow of product from port of receipt to its point of consumption during a baseline year of 1977. This was accomplished by surveying the major petroleum companies shipping through each individual port.

3. Identified the geographical market area served by each port in the baseline year, in most cases coinciding with state boundaries.

4. Projected the portion of forecasted demand that will be consumed in each market area. Distribution of the forecast consumption of each petroleum product to market sectors (residential, utility, etc.) was accomplished by estimating energy use coefficients for the key variables affecting major end user demand. Thus, any future growth, decline, or changes in each state's economy, demography, or social character which would affect energy consumption are accounted for in this process.

5. Distributed the forecasted consumption of petroleum products for each market area among individual ports, by taking the product of total consumption of petroleum served by each port and total consumption projected for each port's market area.

The general trend anticipated for ports along Long Island Sound according to the RPA study is for sharp decline in levels of residual fuel, relative stability in distillate fuel imported, slight decline in gasoline imported, and slight increase in jet fuels and in naphtha (New Haven only). Since residual comprised the largest volume of single product imported, followed by distillate and gasoline, overall petroleum product imports at Connecticut ports along Long Island Sound should be significantly lower by 1995. The trend toward decline in petroleum imports would be expected to begin after 1985, according to the RPA study results. In fact, declining import levels may already be beginning to occur. Thus, it does not appear probable that future port needs will be geared toward providing adequate channel conditions and onshore facilities to handle increased volumes of petroleum. It is possible however, that volumes of approximately the present magnitude will be transported in larger, deeper draft vessels if channel improvements are forthcoming. Actual projected volumes of petroleum product shipments through Long Island Sound ports in Connecticut are shown in Table C-8. A further breakdown of volumes by commodity is listed in Tables C-9, C-10, and C-11.

TABLE C-8

PROJECTED SHIPMENTS OF PETROLEUM PRODUCTS
THROUGH LONG ISLAND SOUND PORTS--CONNECTICUT
(Short Tons)

	1977	1985	1990	1995
New London	1,274,500	1,224,100	1,666,600	872,400
Thames River	307,300	314,400	285,600	274,400
Conn. River	2,055,400	2,387,200	1,895,100	1,630,100
New Haven	8,800,500	8,672,400	8,187,900	7,354,200
Housatonic River	472,900	215,700	241,700	309,000
Bridgeport	2,770,600	2,877,700	2,620,000	2,242,500
Norwalk	779,100	865,600	509,600	497,600
Stamford	514,700	572,700	499,700	486,300
Total	16,975,000	17,129,800	15,406,200	13,666,500

TABLE C-9

PROJECTED SHIPMENTS OF RESIDUAL THROUGH LIS PORTS (CONN)
(Short Tons)

	1977	1985	1990	1995
New London	1,069,000	975,000	953,000	669,000
Thames River	48,000	34,000	35,000	29,000
Conn. River	1,001,000	1,321,000	899,000	629,000
New Haven	2,160,000	2,195,000	2,131,000	1,316,000
Housatonic River	378,000	133,000	161,000	224,000
Bridgeport	1,242,000	1,317,000	1,179,000	799,000
Norwalk	573,000	617,000	296,000	294,000
Stamford	57,000	23,000	27,000	38,000
Total	6,528,000	6,615,000	5,681,000	3,998,000

Source: Projections of Petroleum Product Shipments Through New England Ports, Resource Planning Associates, Inc. September 1979

TABLE C-10

PROJECTED SHIPMENTS OF DISTILLATE THROUGH LIS PORTS (CONN)
(Short Tons)

	1977	1985	1990	1995
New London	199,000	241,000	206,000	245,000
Thames River	157,000	194,000	165,000	157,000
Conn. River	350,000	426,000	364,000	344,000
New Haven	2,999,800	3,353,000	2,960,000	2,796,000
Housatonic River	0	0	0	0
Bridgeport	567,000	731,000	625,000	591,000
Norwalk	196,000	241,000	206,000	195,000
Stamford	436,000	534,000	456,000	431,000
Total	4,904,000	5,720,000	4,982,000	4,709,000

TABLE C-11

PROJECTED SHIPMENTS OF GASOLINE THROUGH LIS PORTS (CONN)
(Short Tons)

	1977	1985	1990	1995
New London	7,000	8,000	8,000	9,000
Thames River	102,000	87,000	85,000	89,000
Conn. River	625,000	541,000	531,000	555,000
New Haven	3,336,000	2,772,000	2,725,000	2,848,000
Housatonic River	95,000	83,000	81,000	85,000
Bridgeport	958,000	825,000	811,000	848,000
Norwalk	10,000	8,000	8,000	9,000
Stamford	21,000	17,000	16,000	17,000
Total	5,154,000	4,341,000	4,265,000	4,460,000

Source: Projections of Petroleum Product Shipments Through New England Ports, Resource Planning Associates, Inc. September 1979

What this data makes obvious is that a major contributing factor in the overall trend toward decreased receipts of petroleum products in Long Island Sound ports is the decrease in residual fuel imported for electric power generation. As Table C-12 indicates, the short tonnage of residual fuel imported at Connecticut ports between 1977 and 1995 is expected to decrease as a percentage of total petroleum imports by approximately 10 percent. On the other hand, distillate fuel and gasoline are expected to increase as a percentage of total petroleum imported.

TABLE C-12

PERCENTAGE OF PETROLEUM SHIPMENT TOTAL
ATTRIBUTABLE TO INDIVIDUAL COMMODITIES
(Projected)

	1977	1985	1990	1995
Residual	38.5	39.5	37.0	29.0
Distillate	29.0	33.0	32.5	34.0
Gasoline	30.0	25.0	27.5	33.0
Jet Fuel	2.0	2.0	2.5	3.0
Naptha	.5	.5	.5	1.0
Total	100%	100%	100%	100%

Source: Projections of Petroleum Product Shipments Through New England Ports, Resource Planning Associates, Inc. September 1979

Reductions anticipated in the absolute volumes of distillate fuel and gasoline are predicated upon an anticipated reduction in per capita demand for those products in the market areas served by individual Long Island Sound ports due to energy conservation measures, such as reduction in miles driven per automobile, increased fuel burning efficiency of automotive engines, improved heat efficiency in newly constructed homes, further insulation of existing residential structures, and the lowering of themostats in residential, commercial, and industrial structures.

Reductions in shipments of residual fuel oil could also be expected to result in part from decreased demand for electricity. However, a reduction of the size projected would necessitate a partial substitute for residual as an energy source, primarily coal. It is anticipated that future levels of coal imports at Long Island Sound ports will increase dramatically over the next few decades due to the increasing cost of petroleum, and a concerted government effort to achieve a greater degree of energy independence in the United States. The Powerplant and Industrial Fuel Use Act of 1978 and subsequent legislation require that all major fuel burning installations (large industrial powerplants and electric utilities), with some exceptions, convert to coal or other nonpetroleum fuels. As a result, it is projected by the U.S. Department of Energy that coal consumption in New England will grow by 34 million short tons between 1977 and 1995. By 1995, DOE estimates that coal consumption will be equal to approximately two-thirds of the total volume of petroleum product shipments projected for New England as a whole.

Officials in the State of Connecticut and spokesmen for the private utility companies operating in that State are somewhat less optimistic about the possibility of DOE's goals being met. Substantial obstacles to coal conversion exist at the present time due to very restrictive environmental standards for coal burning and the capital expenditures necessary for conversion. In many cases, functioning plants are so close to retirement that any capital expenditure of the magnitude suggested would not be feasible.

The future level of petroleum product imports at New York ports along Long Island Sound could be expected to follow the same general trend as described for Connecticut ports. Residual imports could be expected to decline through 1995 due to conversion to other energy sources and efforts to reduce consumption of electricity, partially as a reaction to increased price levels. Quantities of distillate and gasoline imported through New York ports through 1995 could also be expected to remain relatively stable, as is projected at Connecticut ports.

Although quantities of some petroleum products shipped through New York ports may not change radically, the level of activity at some ports may be altered. Proposals are currently under consideration for deauthorization of Federal projects in Manhasset Bay, Hempstead Harbor, Huntington Harbor, and Northport Harbor through phase-outs of petroleum terminals and commercial aggregate activities. To offset these phase-outs of shoreline terminals, construction of new offshore pipeline oil tanker terminals for consolidated petroleum activities in Hempstead Harbor and Port Jefferson Harbor has been suggested. These proposals, in addition to plans for consolidation of deep-draft recreational boating facilities at Glen Cove Creek, Huntington Harbor, Port Jefferson, and Greenport Harbor, are tentative and will be subjected to more detailed study before any decisions about implementation are made.

The purpose of projecting future energy needs in the context of this study is to assist in the determination of future port needs, which in turn dictate future improvement and maintenance dredging needs. Obviously, establishment of a single future scenario for port activity is speculative at best, and a more reasonable approach would establish a range of conditions extending from low growth or no change in port activity to high growth and significant change in channel utilization. The following scenarios are described to reflect this possible range of future port conditions on Long Island Sound:

Minimum Growth, Minimum Change Scenario - Minimum growth would assume that none of the major improvement projects currently proposed will prove justified on economic or environmental grounds, and therefore will not be implemented. Future improvement work would be limited to those small projects currently proposed, including Black Rock Harbor, Clinton Harbor, the Patchogue River, Echo Bay, and New Rochelle Harbor. A minimum amount of improvement work not yet proposed may also be anticipated along the Long Island Sound coast in small boat harbors extensively utilized for recreation and commercial fishing.

Most Probable Future Scenario - Most probable future activity in Long Island Sound ports will reflect some significant changes in channel utilization, though not as extensive as has frequently been anticipated, particularly in the area of coal transport. Although all of the major power generating plants that currently utilize Long Island Sound ports for receipt of petroleum products to fuel their generators are in the midst of studies to determine the feasibility of at least partial conversion to coal, it is probable that only a small number in the State of Connecticut will convert in the near future. The most probable conversion in the foreseeable future would occur at Norwalk, Connecticut, at the Norwalk Harbor plant which presently imports 3.7 million barrels, approximately 600,000 short tons, of residual fuel oil via water and has burned coal as recently as 1972. The plant is considered coal capable and all facilities required to receive an anticipated 890,000 tons of coal are available and operational at the present time. However, the capital expenditures required for conversion are significant, and if installation of scrubbers is required at the time of conversion, the cost would be prohibitive if borne entirely by the private utilities. It should be noted that other commercial and recreational uses of Norwalk Harbor are not expected to change significantly over the planning period.

In addition to the Norwalk Harbor plant, the United Illuminating plant at Bridgeport Harbor may be a likely prospect for conversion of one of three generating units in the future due to the fact that it was designed to operate on coal and the necessary off-loading facilities are available. Conversion of this plant is considered slightly less likely, however due to the fact that the other two generating units are currently burning an ECKO fuel mixture (a mixture of synthetic fuel and residual) that does not burn as clean as petroleum, and conversion of the third generating unit to coal would make the total emission level at the plant in excess of the maximum level allowable.

Other plants generating electrical power in Connecticut including Devon Station (units 1 and 2) on the Housatonic River at Milford, United Illuminating at New Haven, the Montville plant on the Thames River just upstream of New London, and the Middletown plant on the Connecticut River have also been recommended by DOE for possible coal conversion. At the present time, all of these appear highly unlikely for a variety of reasons, such as age of the plant, capital expenditure required for conversion, technical problems, lack of coal off-loading and storage capacity, environmental regulations, and lack of disposal sites for fly ash and bottom ash. State and local planners contacted feel that several major obstacles to conversion still exist, and environmental restrictions are not likely to be relaxed in the near future to alleviate the situation.

Thus, it would appear that the most reasonable assumption for the most likely future of electrical power generators in the Long Island Sound vicinity would be for complete conversion of the Norwalk plant and partial conversion of the Bridgeport plant sometime prior to 1985, with all other plants remaining on residual fuel oil. Although none are planned at present, any new plants constructed to replace existing facilities would be coal burning. It is also possible that some inland plants undergoing feasibility studies for coal conversion, such as West Springfield, Massachusetts and Mt. Tom in Holyoke, Massachusets, will convert to coal and utilize Long Island Sound ports to receive their coal, to be further transported via rail. Studies are currently being conducted to determine whether necessary infra-structure could be provided and still allow a cost efficient operation.

The Norwalk Harbor generating plant is located at the outermost portion of Norwalk Harbor and benefits from naturally deep water in the vicinity of its docking facilities, allowing barge traffic drawing up to 19 feet on appropriate tides even though the authorized channel depth is limited to 12 feet. At the present time, barges delivering residual fuel oil to the plant utilize the channel for only a short distance before entering the naturally deep water adjacent to the plant's location. Therefore, if any future plans for deepening the Norwalk Harbor channel to enable deeper draft vessels to service the power plant are proposed, the distance necessary from the channel entrance to the upstream limit would be minimal. It is presently expected that conversion to coal at Norwalk would be facilitated through the use of barges similar in size to those currently being utilized for petroleum deliveries, and would therefore not require any significant improvements. The improvement portions of the harbor are limited to small barge traffic, which is adequate for present and anticipated needs.

Bridgeport Harbor is currently being studied for possible improvement that would include deepening to 40 feet to accommodate vessels up to approximately 50,000 DWT capacity. This improvement would be justified on the basis of savings in transportation costs to shippers who utilize the channel achieved through the economy of scale provided by the use of larger vessels. The existing trend in the tanker fleet in particular is toward larger, deeper draft vessels.

If coal conversion becomes a reality at Bridgeport Harbor's United Illuminating plant, two of the three generators located there will continue to burn petroleum and adequate depth for available tankers will still be necessary. Vessels suitable for coal delivery are limited in availability at the present time, and if widespread conversion occurs it is anticipated that a fleet of vessels specifically designed to meet the needs of New England ports will be constructed. Although existing modes of coal transport favor barges, the use of colliers up to 40,000 DWT is probable in future years. Barges are generally considered the least costly mode because of their smaller crew size, but are regarded as less dependable and more subject to delays due to inclement weather. Various studies by utilities, barge and tanker lines, and state agencies are underway to determine what mode of transport would offer maximum efficiency. A mixture of tanker, barge, and collier trips through Bridgeport Harbor appears likely in the future to service the power plant, while tanker traffic for the delivery of distillate fuel and gasoline is expected to remain fairly constant after 1985. No other major changes in port utilization at Bridgeport are expected in the foreseeable future.

Both New Haven Harbor and New London Harbor are currently under consideration by the Corps of Engineers for navigation improvements that include channel deepening and widening. These proposed plans are not based on any new or increased port activity projected in the future, but rather on allowing present shipments to be accomplished by more economical larger vessels. It is probable that these improvements will be accomplished over the next 50 year period, though no final plans have been designated.

Other proposed improvement projects which are likely to be implemented in small boat harbors along the Sound are at Black Rock Harbor, Clinton Harbor, the Patchogue River, Smith Cove (Waterford), West River (Guilford), and the Housatonic River (Shelton), as well as Echo Bay and New Rochelle Harbor in Westchester County. Several other small boat harbor improvements not yet proposed will probably be implemented over the study period, allowing expanded recreational use of the sound.

<u>Maximum Growth, Maximum Change Scenario</u> - Maximum growth would assume that all major improvements and small projects currently proposed will actually be implemented and that several additional improvements to commercial and recreational ports will be proposed and implemented over the 50-year project life. In order for these projects to become reality, it would be presupposed that growth and changes in port activity would be significant enough to make them worthwhile. Possible changes which may contribute to the need for future port alterations would be a conversion to coal at all Connecticut power generating plants, as suggested by the Department of Energy, transport of that coal by large deep draft colliers rather than smaller barges, development of container facilities at either Bridgeport or New Haven, or the need for deeper, wider channels for construction of even larger naval vessels at New London. A substantial increase in demand for recreational boating facilities would also be assumed by the maximum growth scenario. An additional factor that would effect the amount of dredging over the next 50 years would be the opening of additional disposal sites in the Long Island Sound. This would particularly effect the western portion of the Sound where prohibitive transportation costs of dredged material have curtailed the amount of non-Federal dredging that has taken place.

IV. PROJECTIONS OF DREDGED MATERIAL QUANTITIES

Future dredging requirements at Long Island Sound ports depend largely on the level of future port activity. Changing conditions in type and level of activity determine the need for channel improvements, as well as for maintenance dredging by the Federal government. A large amount of dredging by non-Federal sources is also common at dockside and between the dock and Federal Channel, at private marinas and yacht clubs, and beyond the limits of Federal Channels and anchorages.

Historical Federal maintenance dredging data covering the period 1948 to the present in Connecticut, and 1927 to the present in New York is shown in Table C-13. Table C-14 lists all non-Corps dredging conducted under Federal permit for the years 1968 to present for both Connecticut and New York.

Projections of future quantities to be dredged from these harbors as Federal maintenance projects are expressed in ranges corresponding to the Minimum Growth/Minimum Change Scenario, the Most Probable Future Scenario, and the Maximum Growth/Maximum Change Scenario, as illustrated by coastal area and port in Tables C-15, C-16, and C-17, respectively. Total quantities calculated on these tables are based on the historical dredging needs of individual ports and anticipated future trends under three different growth conditions. Minimum growth means that funding for maintenance would be scarce over the 50 year study period, user fees may be required, and that most ports would be dredged only when navigation on their channels was actually impeded. In the Most Probable Future Scenario, funds would be allocated for individual port maintenance at approximately the same intervals as they have in the past, with an emphasis on regular maintenance of large commercial ports. The Maximum Growth Scenario would assume that funds would actually be available to maintain all ports at regular intervals to their optimal condition and user fees would not be implemented.

Projected non-Corps dredging along Long Island Sound is more difficult to establish because it is beyond the realm of Federal planning, and would become highly speculative, if not impossible, on a port by port basis. It appears to be a reasonable assumption that dredging by permit will continue at approximately the same rate as it has in the past, excluding consideration of the two major U.S. Navy dredging projects at New London Harbor in recent years. A Minimum Growth Scenario would occur for non-Corps dredging if the recreational boating industry lagged, if proposed improvement work or Federal maintenance work that would spur private dock owners to deepen or widen their own channels are not implemented, if disposal sites are unavailable, or if waterborne commerce becomes outmoded due to changes in New England's economic base. Under such conditions, it has been approximated for the purposes of this report that non-Corps dredging in the future would exist at a rate 20 percent below current levels.

TABLE C-13

HISTORICAL FEDERAL PROJECT MAINTENANCE DREDGING IN LONG ISLAND SOUND

Connecticut Coastal Area (1948-Present)	Project	No. Projects	Freq. (Yr)	Average Vol. Per Project	Year Last Dredged
Western Coastal Area (Incl. Housatonic River)	Greenwich Harbor	1	-	39,800	1968
	Mianus River	1	0	19,730	1964
	Stamford Harbor	2	17	98,625	1979
	Westcott Cove	2	17	17,250	1978
	Fivemile Riv. Har.	1	-	47,700	1968
	Norwalk Harbor	6	5-6	153,690	1980
	Westport Harbor & Saugatuck R.	1	-	25,870	1970
	Southport Hbr	2	14	36,690	1962
	Bridgeport Bridgeport Hbr	6	2-3	227,000	1960
	Housatonic River	3	16	173,660	1976
Central Coastal Area (Incl. Connecticut River)	Milford Harbor	4	8-9	38,395	1980
	New Haven Harbor	15	2	224,220	1979
	Branford Hbr	3	10	85,870	1976
	Stony Creek Harbor	1	-	32,930	1977
	Guilford Hbr	2	10	80,000	1974
	Clinton Harbor	4	6-7	29,200	1976
	Duck Is. Hbr	1	-	132,540	1949
	Patchogue Riv.	4	6-7	33,100	1977
	Connecticut River (Below Htfd)	19	2	184,230	1981
Eastern Coastal Area (Incl. Thames River)	Niantic Bay and Harbor	None	-		
	Thames River	4	6-8	157,880	1966
	New London Harbor	None	-		
	Mystic River	1	-	17,200	1956
	Stonington Harbor	None	-		
	Pawcatuck Riv	3	15	17,560	1977

TABLE C-13 (Cont'd)

New York Coastal Area[a] (1927 - 1976)	Project	No. Projects	Freq. (Yr)	Average Vol. Per Project	Year Last Dredged
Westchester County	Portchester Harbor	5	10	38,540	1966
	Milton	1	-	72,600	1976
	Mamaroneck Harbor	6	5-6	25,930	1981
	Echo Bay	1	-	7,000	1931
	New Rochelle Harbor	3	20[b]	33,000	1971
New York City	Eastchester Creek	6	10	36,820	1974
	Westchester	8	5	119,900	1973
	Bronx River	7	6	72,820	1972
	Flushing Bay & Creek	5	12[b]	113,200	1973
	Harlem River	7	7	43,130	1973
	East River	8	8	39,550	1976
Nassau County	Hempstead	3	11	40,440	1950
	Glen Cove Creek	3	13	20,140	1965
Suffolk County	Huntington Harbor	2	6	12,250	1941
	Port Jefferson Harbor	1	-	37,500	1945
	Mattituck Harbor	9	4	33,920	1980

[a]Data provided by the Corps of Engineers, New York District.
[b]Calculated by dividing the number of years between the first and the last project by the number of intervals between the projects.

TABLE C-14

SUMMARY OF DREDGING/DISPOSAL IN LONG ISLAND SOUND
COASTAL AREAS UNDER FEDERAL PERMIT 1968-1977
(Cubic Yards)

Connecticut Coastal Area	Years and Permitted Volume															Annual Average
	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	Totals	1968-81
Western	20,100	98,200	232,100	55,500	76,300	28,000	4,800	52,100	14,500	81,900	88,057	149,100	121,170	25,300	1,047,027	74,788
Central	43,200	488,600	581,400	98,800	96,200	570,700	142,200	46,000	75,900	115,100	220,000	59,600	68,200	143,750	2,749,650	196,404
Eastern	22,000	65,700	490,000	2,500	115,000	23,000	2,882,000 (2,000)[a]	67,600	23,000	285,800	58,206	2,321,800 (105,800)[a]	22,100	11,600	6,390,206 (1,293,756)[a]	456,443 (92,411)[a]
New York Coastal Area																
Westchester County	11,700	18,400	20,000	19,000	1,000	7,500	2,400	2,500	4,300	18,700	6,500	5,200	26,500	80,000	223,700	16,000
Nassau County	87,500	-	-	1,600	5,200	4,000	1,200	300	-	14,000	31,500	47,400	1,800	200	194,700	13,900
Suffolk Cty	466,000	190,000	47,500	235,000	800	650	10,000	33,340	94,650	7,100	9,200	20,100	13,950	1,050	1,129,240	80,700
New York City[b]	1,300	-	4,100	2,000	-	8,000	5,000	-	2,100	-	4,100	44,000	95,800	228,000	394,400	28,171
Totals[a]	652,000	861,000	1,375,000	414,000	295,000	642,000	3,048,000 (167,600)[a]	202,000	214,000	522,600	417,563	431,200	349,520	489,900	12,128,925 (7,032,473)[a]	866,406 (502,374)[a]

[a]Excluding 1974 New London improvement project by U.S. Navy (2,880,000 cubic yards).
[b]Projects located east of Throgs Neck Bridge only.

TABLE C-15

PROJECTED FEDERAL MAINTENANCE DREDGING
MINIMUM GROWTH SCENARIO - 1985-2035

Coastal Area	Project	Number Projects	Ave.Vol. Per Project	Average Annual Volume	50-Year Cumulative Quantity
Western Connecticut Coastal Area	Greenwich Harbor	1	50,000	1,000	50,000
	Mianus River	1	35,000	700	35,000
	Stamford Harbor	1	100,000	2,000	100,000
	Westcott Cove	1	20,000	800	20,000
	Fivemile River Harbor	2	70,000	2,800	140,000
	Norwalk Harbor	7	150,000	18,000	1,050,000
	Westport Harbor & Saugatuck River	2	35,000	1,400	70,000
	Southport Harbor	2	50,000	2,000	100,000
	Bridgeport Harbor	8	275,000	44,000	1,925,000
	Housatonic River	4	200,000	16,000	800,000
	Total			88,700	4,290,000
Central Connecticut Coastal Area	Milford Harbor	3	40,000	2,400	120,000
	New Haven Hbr	17	225,000	76,500	3,825,000
	Branford Harbor	4	100,000	8,000	400,000
	Stony Creek Harbor	1	35,000	1,400	35,000
	Guilford Harbor	3	80,000	4,800	240,000
	Clinton Harbor	5	30,000	3,600	150,000
	Duck Is. Harbor	1	100,000	2,000	100,000
	Patchogue River	5	50,000	6,000	250,000
	Conn. River (Below Harbor)	22	200,000	80,000	4,400,000
	Total			184,700	9,520,000
Eastern Connecticut Coastal Area	Niantic Bay & Harbor	1	40,000	1,600	40,000
	Thames River	4	200,000	12,000	800,000
	New London Harbor	0	---	---	0
	Mystic River	1	25,000	500	25,000
	Stonington Harbor	0	---	---	0
	Pawcatuck River	3	25,000	1,500	75,000
	Total			15,600	940,000

TABLE C-15 (Cont'd)

Coastal Area	Project	Number Projects	Ave.Vol. Per Project	Average Annual Volume	50-Year Cumulative Quantity
Westchester County	Port Chester	4	40,000	3,200	160,000
	Milton	0	-	-	-
	Mamaroneck	4	30,000	2,400	120,000
	Echo	0	-	-	-
	New Rochelle	1	30,000	600	30,000
	Total			6,200	310,000
Nassau County	Hempstead	2	40,000	1600	80,000
	Glen Cove Creek	2	20,000	800	40,000
	Total			2,400	120,000
Suffolk	Huntington	1	12,000	240	12,000
	Port Jefferson	0	-	-	-
	Mattituck		35,000	3,500	175,000
	Total			3,740	187,000
New York City	East Chester	4	35,000	2,800	140,000
	West Chester	6	120,000	14,400	720,000
	Bronx River	6	70,000	8,400	420,000
	Flushing Bay & Creek	3	110,000	6,600	330,000
	Harlem River	4	40,000	3,200	160,000
	East River	4	40,000	3,200	160,000
	Total			38,600	1,930,000
Total Long Island Sound				339,940	17,297,000

TABLE C-16

PROJECTED FEDERAL MAINTENANCE DREDGING
MOST PROBABLE FUTURE SCENARIO--1985-2035

Coastal Area	Project	Number Projects	Ave. Vol. Per Project	Average Annual Volume	50-Year Cumulative Quantity
Western Coastal Area	Greenwich Harbor	2	50,000	2,000	100,000
	Mianus River	2	35,000	1,400	70,000
	Stamford Harbor	2	100,000	5,000	200,000
	Westcott Cove	3	20,000	1,200	60,000
	Fivemile River Hbr.	2	70,000	4,200	140,000
	Norwalk Harbor	9	150,000	21,000	1,350,000
	Westport Harbor & Saugatuck River	2	35,000	2,100	70,000
	Southport Harbor	3	50,000	3,000	150,000
	Bridgeport Harbor	9	275,000	55,000	2,475,000
	Housatonic River	5	200,000	20,000	1,000,000
	Total			112,900	5,615,000
Central Coastal Area	Milford Harbor	6	40,000	4,800	240,000
	New Haven Harbor	22	225,000	99,000	4,950,000
	Branford Harbor	5	100,000	10,000	500,000
	Stony Creek Harbor	2	35,000	2,100	70,000
	Guilford Harbor	3	80,000	6,400	240,000
	Clinton Harbor	6	30,000	4,200	180,000
	Duck Is. Harbor	2	100,000	4,000	200,000
	Patchogue River	7	50,000	7,000	350,000
	Conn. River (Below Hartford)	28	200,000	100,000	5,600,000
	Total			241,500	12,330,000
Eastern Coastal Area	Niantic Bay & Harbor	2	40,000	2,400	80,000
	Thames River	6	200,000	16,000	1,200,000
	New London Harbor	2	100,000	10,000	200,000
	Mystic River	2	25,000	1,000	50,000
	Stonington Harbor	0	--	--	--
	Pawcatuck River	4	25,000	2,000	100,000
	Total			31,400	1,630,000

TABLE C-16 (Cont'd)

Coastal Area	Project	Number Projects	Ave.Vol. Per Project	Average Annual Volume	50-Year Cumulative Quantity
Westchester County	Port Chester	5	40,000	4,000	200,000
	Milton	0	-	-	-
	Mamaroneck	5	30,000	3,000	150,000
	Echo	0	-	-	-
	New Rochelle	2	30,000	1,200	60,000
	Total			8,200	410,000
Nassau County	Hempstead	3	40,000	2,400	120,000
	Glen Cove Creek	3	20,000	1,200	60,000
	Total			3,640	180,000
Suffolk County	Huntington	1	12,000	240	12,000
	Port Jefferson	1	35,000	700	35,500
	Mattituck	8	35,000	5,600	280,000
	Total			6,540	327,000
New York City	East Chester	5	35,000	3,500	175,000
	West Chester	8	120,000	19,200	960,000
	Bronx River	7	70,000	9,800	490,000
	Flushing Bay & Creek	4	110,000	8,800	440,000
	Harlem River	5	40,000	4,000	200,000
	East River	5	40,000	4,000	200,000
	Total			49,300	2,505,000
Total Long Island Sound				456,380	22,997,000

TABLE C-17

PROJECTED FEDERAL MAINTENANCE DREDGING
MAXIMUM GROWTH SCENARIO--1985-2035

Coastal Area	Project	Number Projects	Ave.Vol. Per Project	Average Annual Volume	50-Year Cumulative Quantity
Western Coastal Area	Greenwich Harbor	3	50,000	3,000	150,000
	Mianus River	3	35,000	2,100	105,000
	Stamford Harbor	3	100,000	6,000	300,000
	Westcott Cove	4	20,000	1,600	80,000
	Fivemile River Hbr.	4	70,000	5,600	280,000
	Norwalk Harbor	8	150,000	24,000	1,200,000
	Westport Harbor & Saugatuck River	4	35,000	2,800	140,000
	Southport Harbor	4	50,000	4,000	200,000
	Bridgeport Harbor	12	275,000	66,000	3,300,000
	Housatonic River	6	200,000	20,000	1,200,000
	Total			139,100	6,955,000
Central Coastal Area	Milford Harbor	5	40,000	4,000	200,000
	New Haven Harbor	23	225,000	103,500	5,175,000
	Branford Harbor	6	100,000	12,000	600,000
	Stony Creek Harbor	4	35,000	2,800	140,000
	Guilford Harbor	5	80,000	8,000	400,000
	Clinton Harbor	8	30,000	4,800	240,000
	Duck Is. Harbor	3	100,000	6,000	300,000
	Patchogue River	8	50,000	8,000	400,000
	Conn. River (Below Hartford)	33	200,000	108,000	5,400,000
	Total			257,100	12,855,000
Eastern Coastal Area	Niantic Bay & Harbor	4	40,000	3,200	160,000
	Thames River	5	200,000	20,000	1,000,000
	New London Harbor	5	100,000	10,000	500,000
	Mystic River	3	25,000	1,500	75,000
	Stonington Harbor	--	--	--	--
	Pawcatuck River	5	25,000	2,500	125,000
	Total			37,200	1,860,000

TABLE C-17 (Cont'd)

Coastal Area	Project	Number Projects	Ave.Vol. Per Project	Average Annual Volume	50-Year Cumulative Quantity
Westchester County	Port Chester	5	40,000	4,000	200,000
	Milton	1	50,000	1,000	50,000
	Mamaroneck	6	30,000	3,600	180,000
	Echo	1	10,000	200	10,000
	New Rochelle	3	30,000	1,800	90,000
	Total			10,600	530,000
Nassau County	Hempstead	4	40,000	3,200	160,000
	Glen Cove Creek	3	20,000	1,200	60,000
	Total			4,400	220,000
Suffolk County	Huntington	2	12,000	480	24,000
	Port Jefferson	1	35,000	700	35,000
	Mattituck	10	35,000	7,000	350,000
	Total			8,180	409,000
New York City	East Chester Creek	5	35,000	3,500	175,000
	West Chester Creek	10	120,000	24,000	1,200,000
	Bronx River	8	70,000	11,200	560,000
	Flushing Bay & Creek	4	110,000	8,800	440,000
	Harlem River	7	40,000	5,600	280,000
	East River	7	40,000	5,600	280,000
	Total			58,700	2,935,000
Total Long Island Sound				515,280	25,764,000

On the other hand, if significant improvements either currently proposed or not yet proposed are implemented by the Federal government, private interests may be encouraged to match the improved conditions at their own dock facilities, thus resulting in a larger quantity of dredge material. Additional conditions favorable to future port development, such as continued rapid growth of the recreational boating industry, continued expansion of the commercial fishing industry as a result of the 200 mile limit on territorial waters, the establishment of waterborne commerce as the most economical mode of transport due to increased costs of alternatives and the opening of additional disposal sites may also result in an increased future rate of private dredging initiatives. For purposes of this study, the Maximum Growth Scenario assumes an increased future rate of non-Corps dredging to approximately 20 percent greater than current levels. Projected quantities of dredged material under all three scenarios are shown in Table C-18 for each of the three coastal areas and for Long Island Sound as a whole.

TABLE C-18

PROJECTED NON-CORPS DREDGING BY PERMIT--1985-2035

Coastal Area	Minimum Growth Scenario	Most Probable Future Scenario	Maximum Growth Scenario
Connecticut:			
Western	2,992,000	3,740,000	4,488,000
Central	7,856,000	9,820,000	11,784,000
Eastern	18,260,000	22,825,000	27,390,000
	(3,696,000)[a]	(4,620,000)[a]	(5,544,000)[a]
New York:			
Westchester County	640,000	800,000	960,000
Nassau County	556,000	695,000	834,000
Suffolk County	3,328,000	4,035,000	4,842,000
New York City	1,128,000	1,410,000	1,692,000
Total	34,660,000	43,325,000	51,990,000

[a] Excluding New London Harbor Improvement by U.S. Navy.

Several proposed navigation improvements along Long Island Sound were taken into consideration in projecting future Federal improvement dredging quantities. The minimum growth scenario, as previously described, would limit future improvement work to a few currently proposed small boat harbor projects plus a minimal amount of dredging not currently proposed, estimated at 200,000 cubic yards (c.y.) in each coastal area. A total of 1,510,000 c.y. of dredge material is outlined in Table C-19.

TABLE C-19

PROJECTED FEDERAL IMPROVEMENT DREDGING
MINIMUM GROWTH SCENARIO—1985-2035

Coastal Area	Project	Quantity Dredged (C.Y.)
Connecticut:		
Western	Black Rock Harbor	150,000
	Others (not yet proposed)	200,000
Total		350,000
Central	Clinton Harbor	230,000
	Patchogue River	30,000
	Others (not yet proposed)	200,000
Total		460,000
Eastern	Not yet proposed	200,000
New York:		
Westchester County	Not yet proposed	100,000
Nassau County	Not yet proposed	100,000
Suffolk County	Not yet proposed	100,000
New York City	Not yet proposed	200,000
Total		500,000
LIS Total		1,510,000

Quantities of future dredged material resulting from Federal improvements associated with the Most Probable Future and Maximum Growth Scenarios are presented by port and coastal area in Tables C-20 and C-21, respectively. Both scenarios are based on the assumption that all proposals currently under consideration will actually be implemented and the specific quantities associated with them will require new disposal sites. The major difference between the two scenarios is that an additional 300,000 c.y. of material per coastal area is estimated for projects not yet proposed under the Most Probable Future, and an additional 500,000 c.y. per coastal area under Maximum Growth conditions.

Total anticipated quantities of dredged materials resulting from all categories of dredging activity over the study period for each possible future scenario defined are summarized by Table C-22. Although the total range from minimum to maximum quantities is broad, approximately 53,467,000 c.y. of material compared with 92,864,000 c.y., the estimates must reflect the need for flexible planning over a period of 50 years due to the transitional nature of port activity in the Long Island Sound region, the unpredictable nature of the primary channel use in major commercial ports and the uncertainty of funding available.

TABLE C-20

PROJECTED FEDERAL IMPROVEMENT DREDGING
MOST PROBABLE FUTURE SCENARIO--1985-2035

Coastal Area	Project	Quantity Dredged (C.Y.)
Connecticut:		
Western	Bridgeport Harbor	2,500,000
	Black Rock Harbor	150,000
	Others Not Yet Proposed	300,000
Total		2,950,000
Central	New Haven Harbor	7,200,000
	Clinton Harbor	230,000
	Patchogue River	30,000
	Others Not Yet Proposed	300,000
Total		7,760,000
Eastern	New London Harbor	1,600,000
	Others Not Yet Proposed	300,000
Total		1,900,000
New York:		
Westchester County	Echo Bay	150,000
	New Rochelle Harbor	150,000
	Others not yet proposed	100,000
Nassau County	Not yet proposed	150,000
Suffolk County	Not yet proposed	150,000
New York City	Not yet proposed	300,000
Total		1,000,000
LIS Total		13,350,000

TABLE C-21

PROJECTED FEDERAL IMPROVEMENT DREDGING
MAXIMUM GROWTH SCENARIO--1985-2035

Coastal Area	Project	Quantity Dredged (C.Y.)
Connecticut:		
Western	Bridgeport Harbor	2,500,000
	Black Rock Harbor	150,000
	Others Not Yet Proposed	500,000
		3,150,000
Central	New Haven Harbor	7,200,000
	Clinton Harbor	230,000
	Patchogue River	30,000
	Others Not Yet Proposed	500,000
Total		7,960,000
Eastern	New London Harbor	1,600,000
	Others Not Yet Proposed	500,000
Total		2,100,000
New York:		
Westchester County	Echo Bay	150,000
	New Rochelle Harbor	150,000
	Others not yet proposed	300,000
Nassau County	Not yet proposed	400,000
Suffolk County	Not yet proposed	400,000
New York City	Not yet proposed	500,000
Total		1,900,000
LIS Total		15,470,000

TABLE C-22

SUMMARY OF PROJECTED DREDGED MATERIAL QUANTITIES (C.Y.)
1985-2035

Scenario	Coastal Area	Federal Maintenance Dredging	Non-Federal Dredging	Federal Improvement Dredging	Total
Connecticut:					
Minimum Growth	Western	4,290,000	2,992,000	350,000	7,632,000
	Central	9,520,000	7,856,000	460,000	17,836,000
	Eastern	940,000	18,260,000	200,000	19,400,000
	Total	14,750,000	29,108,000	1,010,000	44,868,000
Most Probable Future	Western	5,615,000	3,740,000	2,950,000	12,305,000
	Central	12,330,000	9,820,000	7,760,000	29,910,000
	Eastern	1,630,000	22,825,000	1,900,000	26,355,000
	Total	19,575,000	36,385,000	12,610,000	68,570,000
Maximum Growth	Western	6,955,000	4,488,000	3,150,000	14,593,000
	Central	12,855,000	11,784,000	7,960,000	32,599,000
	Eastern	1,860,000	27,390,000	2,100,000	31,350,000
	Total	21,670,000	43,662,000	13,210,000	78,542,000
New York:					
Minimum Growth	Westchester Cty	310,000	640,000	100,000	1,050,000
	Nassau County	120,000	556,000	100,000	776,000
	Suffolk County	187,000	3,228,000	100,000	3,515,000
	New York City	1,930,000	1,128,000	200,000	3,358,000
	Total	2,547,000	5,552,000	500,000	8,599,000
Most Probable Future	Westchester County	410,000	800,000	400,000	1,610,000
	Nassau County	180,000	695,000	150,000	1,025,000
	Suffolk County	327,000	4,035,000	150,000	4,512,000
	New York City	2,505,000	1,410,000	300,000	4,215,000
	Total	3,422,000	6,940,000	1,000,000	11,362,000
Maximum Growth	Westchester Cty	530,000	960,000	600,000	2,090,000
	Nassau County	220,000	834,000	400,000	1,454,000
	Suffolk County	409,000	4,842,000	400,000	5,651,000
	New York City	2,935,000	1,692,000	500,000	5,127,000
	Total	4,094,000	8,328,000	1,900,000	14,322,000
Total					
Minimum Growth		17,297,000	34,660,000	1,510,000	53,467,000
Most Probable Future		22,997,000	43,325,000	13,610,000	79,932,000
Maximum Growth		25,764,000	51,990,000	15,110,000	92,864,000

V. ALTERNATIVE METHODS OF DISPOSAL AND THEIR ECONOMIC IMPACTS

As previously described in other sections of this study, alternative methods of dredged material disposal can be categorized into four major groups: aquatic, including both confined and spreading methods; aquatic containerization, either shorefront or as an island; upland disposal, often for fill, habitat development, or other useful purposes; and a general group of disposal options such as beach restoration and incineration, merely labeled as "other." Each of these categories would present distinct economic advantages or disadvantages, either by virtue of cost involved in the actual disposal operation or through sustained economic gain or loss due to use of the material for beneficial purposes or the elimination of an ongoing or potential gainful use. Many of these impacts can be identified in general terms in the context of the disposal alternatives discussed in this report, and further refinement will become possible as these options become better defined and site-specific.

As existing disposal sites approach exhaustion, the necessity for development of new feasible solutions to the anticipated future disposal problem becomes more imminent. Although it is improbable that no future dredging may be allowed due to the lack of disposal sites, that extreme possibility must be considered because of the severe economic impact that would be felt throughout the region. A more realistic future possibility would be that in the absence of any broad scale disposal plan, a greatly reduced dredging program at infrequent intervals and great cost would result. The impacts of a no action alternative or a severely limited future dredging alternative are similar in nature.

The major effects of no action/limited action would be borne by receivers of petroleum products because they currently utilize the channels most extensively. Power generators, dependent on water transport for delivery of residual fuel oil to produce electricity, would be adversely effected to a very significant degree if channel depths became even more restrictive in the future. Presently dependent on foreign fuel as their major source of supply, the most economical means of transporting the residual over long distances is via the largest tanker that can be accommodated because the cost per unit shipped decreases as tanker size increases. Also, frequent substantial economic costs due to tidal delays are encountered when vessels are required to wait for high water conditions before approaching a terminal to unload their cargo. All of these additional costs are ultimately passed on to the consumer in the form of higher electric rates, further impacting on all areas of the economy by providing a disincentive for commercial and industrial growth.

If widespread conversion to coal as a source of fuel for electrical generation becomes a future reality as suggested by the U.S. Department of Energy, the impacts of inadequate channel conditions would be similar. The economy of scale achievable through the use of maximum sized vessels would be precluded as a possibility, and additonal costs would be passed on the the consumer.

Similar negative effects would be borne by receivers of other petroleum products, particularly distillate fuel for home heating and gasoline for automotive use. Rapidly escalating costs have placed a discernible financial burden on home and car owners and reduced the portion of their expendable income that would normally be spent on durable goods, leisure activities, or other preferences. If inadequate future channel depths resulted in increased transportation costs reflected by increased prices of home heating oil and gasoline, total spending would remain high, ability to save would decrease, and an even larger percentage of expendable income would be diverted from nonfuel uses.

Although the economy of the region surrounding Long Island Sound has passed through a transition period from a manufacturing base that produced bulk commodities suited for a water transport to a more service oriented base, with manufacturing activity inclined toward the electronic and chemical industries, some bulk commodity movement is still dependent on adequate port conditions. The importance of sand, gravel, and crushed stone shipments over water will increase as local sources diminish and alternative transport modes increase in cost. If the iron and steel scrap export business is to survive along Long Island Sound, channel depths will have to be maintained because the principal markets have shifted to foreign ports and use of larger vessels has therefore become desirable. Although there are currently no definite plans for development of a container port in the region, the no action/limited action alternative would preclude that possibility as a means of future economic growth.

The significance of recreational boating to the regional economy should not be overlooked in consideration of the impacts of limited future dredging. Powerboating and sailing have grown rapidly in popularity over the most recent decade, as evidenced by the waiting lists for mooring facilities common at yacht clubs and marinas along the Sound. The larger the boat, the greater the investment necessary and the deeper the draft required, particularly in the case of sailing vessels. Thus, as channel conditions deteriorated and future dredging operations diminished, boat owners would become less and less likely to realize a suitable return on their investment. Channel passage for larger boats would be restricted to high tide conditions, and more frequent groundings would cause additional vessel damages. As the region became less attractive as a site for boating activity, economic losses would be sustained by boat owners, marina owners, boat manufacturers, and over the long run, boat repair yards. Several ancillary businesses, such as sporting goods stores, dockside gasoline dealers, bait and tackle shops, and fast food services would also be negatively impacted by a decrease in recreational boating.

The no action/limited action alternative would also negatively impact on commercial fishing at Long Island Sound ports. With the future of the industry looking optimistic due to increased fish stocks resulting from successful implementation of the 200 mile limit, applies to fishing rights only, the prospect for substantial gains in the contribution of commercial fishing to the regional economy is not unrealistic. However, the trend in the industry is toward the use of larger more diversified vessels, and shallow conditions at any given port may preclude the possibility of expansion.

Aquatic Disposal - The first major group of disposal alternatives to consider is Aquatic Disposal, both confined and spreading. Included in this group are Open Ocean (Open Water) Disposal, Aquatic Habitat Development, Island Habitat Development, Subaqueous Borrow Pits, and River and Harbor disposal, all described in detail elsewhere in this report.

Many of these subcategories of aquatic disposal share common characteristics. All must be assessed in light of the effect that their implementation would have on marine life, from an economic as well as an environmental perspective. As each potential specific disposal site is considered, the likely effect on commercial fisheries, particularly shellfisheries, will require thorough evaluation.

The total cost of each aquatic disposal option would also depend largely on the distance of disposal sites from the actual dredging operation. When hydraulic dredges are utilized, a vacuum system sucks the bottom material through a pipeline and casts it onto a disposal site. In many cases, some type of a containment structure would be necessary to prevent the material from flowing back into the adjacent waterway. Any containment effort would obviously increase disposal costs significantly, unless natural depressions are used.

The alternative dredging method is by bucket or clamshell dredge, which requires auxiliary disposal equipment such as barges or dump scows, capable of operating in either shallow or deep water. In general, under ideal conditions where a disposal site is in close proximity to the dredging site (within approximately 1 mile) and at the same elevation (within approximately 10 feet) as the dredging site, hydraulic dredging is less expensive and more efficient than clamshell dredging. At greater distances and where the disposal site is at a much higher elevation than the dredging site, additional pumps are necessary, causing an increase in costs and decrease in efficiency. Clamshell dredging is somewhat less efficient because material must be double handled, e.g. excavated by dredge, loaded onto a scow or barge, and either barged to an aquatic dump site or transported to shore and loaded onto trucks for disposal at a land site.

Because disposal sites within close proximity of project sites are frequently unavailable, clamshell dredging and subsequent disposal at an open water site has become the preferred method for Federal projects in the Long Island Sound area. This, however, is not true of dredging accomplished in the private sector, where land disposal sites are more frequently used. As indicated by Tables C-23 and C-24, 92 percent of all

Corps dredging in the Long Island Sound area between 1961 and 1979 utilized aquatic disposal sites, as compared with 45 percent of private dredging under Federal permit over approximately the same period. The quantities shown include all dredging of specified volumes in all Connecticut and New York ports along Long Island Sound. Projected future quantities of dredged material shown in Table C-18 of this appendix assume that non-Corps dredging by permit will continue in the future at approximately the same rate as in past years. Thus, it may reasonably be assumed that those quantities will continue to be disposed of at land sites, with the largest percentage of projected material from Corps projects being disposed of at aquatic sites.

TABLE C-23

DISPOSAL METHODS FOR CORPS OF ENGINEERS DREDGING IN
LONG ISLAND SOUND (1961 - 1979)
(Thousand Cubic Yards)

Coastal Area	Total Volume	Disposal Method, Quantity and Percent of Total: Land	%	Water	%
Westchester Co., NY	583	0	0	583	100
Nassau Co., NY	7	0	0	7	100
Suffolk Co., NY	108	108	100	0	0
New York City	6,270	0	0	6,270	100
Western Conn.	595	184	31	411	69
Central Conn.	1,413	427	30	986	70
Eastern Conn	237	0	0	237	100
Total	9,213	719	8	8,494	92

TABLE C-24

DISPOSAL METHODS FOR PRIVATE DREDGING UNDER
FEDERAL PERMIT IN LONG ISLAND SOUND (1961 - 1979)
(Thousand Cubic Yards)

Coastal Area	Total Volume	Disposal Method, Quantity, and Percent of Total: Land	%	Water	%
Westchester Co., NY	455	354	77.8	101	22.2
Nassau Co., NY	518	399	77.0	119	23.0
Suffolk Co., NY	4,738	4,483	94.5	255	5.5
New York City	5,304	843	15.9	4,461	84.1
Total	11,015	6,079	55	4,936	45

Note: Accurate data for this time period showing volumes of dredged material disposed of on land and in water are not available for private dredging under Federal permit from the New England Division.

In the Long Island Sound area potential land disposal sites, particularly for large scale Corps projects, are scarce. (Economic impacts of land disposal will be treated later in this report.) Therefore, the economic impacts of different methods of aquatic disposal must be carefully scrutinized.

The most frequently employed method of aquatic disposal is open water disposal, referring to disposal of dredged material on the sea bottom in areas unattached to the shore and remaining submerged at all times. The number of active open water disposal sites in Long Island Sound has been reduced from 19 to 3, including New Haven, Cornfield Shoals, and New London. Research embodied in Appendix A has identified the following as suitable disposal sites:

1. Bridgeport East - Located approximately 3.1 miles south of the Bridgeport/Pequonnock River Entrance Channel, where water depths range from 52 to 79 feet.

2. Branford Dredged Material Disposal Site - Approximately 7.5 miles south of Branford, Connecticut and 6.2 miles southeast of New Haven Harbor Entrance Channel, with water depths ranging between 59 and 75 feet.

3. Six Mile Reef - Approximately 11 miles southwest of the entrance to the Connecticut River and 9 miles south of Clinton, Connecticut, where water depths range from 49 to 108 feet.

4. Block Island Sound - About 11 miles northwest of Block Island, 7.5 east of Fishers Island, and 5.5 miles southeast of Watch Hill Point, Rhode Island, in water ranging from 98 to 112 feet in depth.

5. Eatons Neck East - Located approximately 3.5 miles north northeast of Eatons Neck, Long Island and 4 miles south of Sheffield Island, Connecticut, with water depths ranging from 49 to 190 feet.

6. New Haven - Central Long Island Sound Regional Disposal Area - Located 5 miles south of the New Haven Entrance Channel in water 49 to 75 feet deep.

7. New London Disposal Area - Approximately 2 miles south of the entrance to the New London Harbor Channel (Thames River) and 2.5 miles west of Fishers Island, Conn. Water depths range from 49 to 82 feet.

These seven identified sites should not be considered an exhaustive list. Since the time that the study was conducted, an additional site, WLIS III, has been identified. The WLIS III disposal site is located within the triangle bordered by the Stamford disposal site on the west, the South Norwalk disposal site on the northeast and the Eaton's Neck disposal site on the east. It occupies an "east-west" oriented trench which ranges in depth from 115 feet in the valley to 80-90 feet along its upper sides. This site may be suitable to serve the needs of Western Long Island Sound. An Environmental Impact Statement has been published regarding WLIS III and its use began in March 1982.

It is unknown whether or not other sites will eventually be designated as active disposal areas. The sites mentioned above also serve as a means of analyzing the relationship of transport distance to local disposal cost in the Long Island Sound area.

The potential economic consequences associated with using any or all of the seven recommended areas as future disposal sites would result primarily from changes in unit dredging cost ($/cubic yard). The unit dredging costs would, in turn, be affected by the change in the transportation component - the costs incurred in barging the material from the dredging area to a designated disposal area. Unit transportation costs ($/cubic yard/mile) are a function of the type of equipment used: size of the barge, size of the tug, towing speed, number of barges towed, and accompanying capital and operating cost (e.g., fuel cost, labor, depreciation, and repair).

The unit transport costs are constant up to a distance of approximately 19 miles. Beyond this point, unit transportation costs begin to increase due to overtime costs, as well as the greater likelihood that offshore weather conditions will inhibit or stop dumping activities.

The primary determinant of unit dredging costs is the ability to maintain continuous operation of the dredge. Longer hauling distances would increase unit dredging costs as additional tugs and barges are required to keep a dredge in continuous operation. A longer round trip time greatly reduces the number of daily trips a tug and barge can make to the disposal site. This in turn requires the presence of additional tugs and barges to provide additional carrying capacity. The net result is that capital and operating costs must go up, or if additional equipment is not available, productivity diminishes while the dredge idles until a barge becomes available.

The unit transportation cost for a commonly employed tug/barge combination has been estimated at 6.2¢/cubic yard/mile (Dames and Moore, 1980). This unit transportation cost was based on information obtained from interviews with dredging contractors, an examination of historical dredging costs in Long Island Sound and on current prices for barges, tug rental rates, fuel and labor costs. It is recognized that unit transportation costs for smaller pieces of equipment used in small harbor and marina dredging would be significantly higher. The above function assumes the use of an 1800 hp tug towing one 2000 cubic yard scow at 6 statute miles per hour. The mileage refers to one way distance to a disposal site, but allows for the round trip distance.

Unit dredging costs are also affected by the project size. An examination of unit dredging costs incurred on Corps projects utilizing open water disposal in Connecticut over the 10-year period 1968-1977 yields a very approximate inverse relationship between job size and unit cost. That is, unit dredging costs do decline as the project size increases. This is consistent with information gained from talks with dredging contractors, and the expectation that larger jobs allow the use of larger capacity dredges and barges which result in economies of scale in terms of productivity. All other things being equal (material type, transport distance, disposal site), the larger the job, the lower the unit dredging costs are likely to be.

The issue of job size has significant implications concerning the incidence of economic impacts on private projects utilizing Long Island Sound disposal sites under a Federal permit. Between 1968 and 1977, private dredging projects averaged approximately 16,800 cubic yards in size, excluding the dredging of the Navy's submarine base at New London (Energy Resources Company, 1979). Over the same period, Corps of Engineers jobs (new work and maintenance) averaged approximately 110,000 cubic yards in size. Given that there are economies of scale in dredging (including the transporting of spoil to open water disposal sites), it is apparent that private sector unit dredging costs were higher in the Long Island Sound area during this period.

The size and unit cost differentials between Corps and non-Corps dredging projects indicate that changes in the location of disposal areas would have a proportionally more severe economic effect on private dredging jobs. One major reason that private jobs are more expensive is the small size and shallow depth of the municipal, non-Corps maintained harbors and marinas located along the Sound. These physical constraints limit the size of the equipment that can be used. For example, a 2,000 cubic yard bottom dumping barge draws between 15 and 18 feet of water when loaded and has dimensions of approximately 200' x 50'. This precludes its use in smaller harbors and marinas and means that smaller, less efficient equipment must be used. Similar size constraints apply to the use of large mechanical dredges on small jobs.

A comparison between the different dredging and transport modes showed clearly that the smaller unit (500 cubic yard barge, 3 cubic yard mechanical dredge) had higher unit transportation costs of approximately $.14/cubic yard/mile (Dames and Moore, 1980). Thus the smaller average size of many private dredging projects necessitates the use of less efficient equipment (economies of scale in dredging and transport cannot be captured), and the higher unit transport costs imply a greater increase in unit dredging costs as the distance to a disposal site increases.

Changes in unit dredging costs as affected by changes in the transportation component will affect two primary sectors in the study area, the small local marine trades and the firms involved in waterborne commerce. The small local marine trade firms include marinas, recreational boating dealers, and local dredging firms. Organizations engaged in waterborne commerce include terminal companies, shippers, petroleum storage and distribution firms, and municipal port authorities. Both of the above sectors are dependent upon periodic dredging, either by private means or the Corps of Engineers, to help maintain the economic viability of their operations. The importance of waterborne commerce to the Long Island region is indicated by the fact that approximately 26.6 million metric tons of cargo were handled in Long Island ports in 1977, about 15 percent of the total for the entire port of New York (Department of the Army, Corps of Engineers, 1977).

The use of the present three disposal sites in Long Island Sound has had an adverse economic impact on water-oriented businesses that depend upon periodic maintenance dredging for their economic viability. The closing down of some of the closer, historic dumping areas in the Sound, particularly Eatons Neck, has contributed to the economic decline in the recreational boating industry in Connecticut in recent years (Berrien, 1979). An example of this increased cost of doing business for marinas is shown in the estimates received by the Cedar Island Marina in Clinton, Connecticut for necessary maintenance dredging. The estimate for disposal of 20,000 cubic yards at the old Clinton site (currently closed) was approximately $49,000 as compared to $82,500 at the Cornfield Shoals site and $178,000 at the New Haven disposal site. For this marina, the difference between disposal at the Clinton site and Cornfield Shoals amounts to an additional annual expense of $33,500, a 68 percent annual increase in the largest component of their total maintenance cost.

The closing of historic disposal areas in the Sound and the use of the three current regional disposal sites has also had an adverse impact on small local dredging companies in the Long Island Sound area. The increased haul distance to disposal areas has decreased the competitiveness of the small dredging company in that they do not have the additional equipment necessary to keep their dredges in continuous operation. Similarly, the small pieces of equipment needed to service the small harbor and marinas along the coast are generally not capable of capturing economies of scale in transporting the material and their unit dredging costs have risen significantly. Small operators have had to branch into other areas of work, lost revenues as marinas have found maintenance dredging too costly to do as frequently as they have in the past, or have affiliated with other firms to retain economic viability (Rudd, Molloy, 1979).

The size and type (adverse or positive) of economic impact associated with the potential use of the seven recommended sites as disposal areas depends on how many of the sites would in fact be used. The use of only one of the seven sites would create a situation worse than the existing situation. The average distance from any potential dredging project to the disposal area would increase over the present average, thus increasing transportation and unit dredging costs. Conversely, the use of all seven sites recommended in this report as dredge spoil disposal areas would be likely to have a positive economic impact on water dependent economic activities in the Long Island Sound area. Marinas, marine contractors, dredging companies, and concerns involved in waterborne commerce, all of whom depend on periodic maintenance dredging, would benefit as the average distance to the nearest disposal site would (in most instances) be less than the current distances to the three regional sites. The exceptions would be those in which disposal characteristics would require disposal at a site whose physical characteristics would minimize potential environmental impacts.

The use of all seven of the recommended areas would not be likely to increase the cost of dredging carried out by the Corps of Engineers as part of their responsibility in maintaining navigable waterways. The transport distances would certainly not increase over current distances, and in some instances could decrease. The location of the proposed sites in Long Island and Block Island Sounds means that the additional investment that would be required to undertake continental shelf disposal would not be necessary. Similarly, the high transport costs associated with a 60 or 75 mile one-way trip would not be incurred.

The recommended Block Island Sound site would provide a disposal area for dredging work done in Rhode Island. The closing down of the Brenton Reef disposal area off Rhode Island has created a substantial backlog of much needed dredging work in Rhode Island.

> "The dredging and dredged material disposal impasse is creating severe economic problems in Rhode Island. Dredging must be undertaken soon in several areas along the Providence commercial waterfront if this area is to remain competitive with other ports and harbors along the eastern seaboard. The lack of disposal areas for this material has already limited or indefinitely delayed the development and expansion programs at the Providence Port Authority and several private corporations dependent on navigable waterfront . . ." (Seavey and Pratt, 1979).

The precise economic impacts are difficult to judge because future estimates concerning the location of projects relative to disposal sites are difficult to make. The key issue is to what extent future transportation costs for the disposal of dredged material within the Long Island Sound region would change. The recommended sites are all within Long Island and Block Island Sound coastal waters. Sites 1, 3, 4, and 5 would provide disposal locations for sections of the Sound that are not presently near any of the three regional sites. In particular, sites 5 (western Long Island Sound) and 4 (Block Island Sound) may provide opportunities for the disposal of dredged material from projects that have not been completed partially because of high transportation costs.

The economic impacts of hauling dredge spoil to open ocean sites near the continental shelf would be very significant. Previous environmental suitability studies indicate a potentially acceptable disposal area located just south of the 40° 31′ north latitude. This area lies approximately 75 statute miles from New London, Connecticut.

Transporting dredge spoil to this site would require a round trip of 150 statute miles, and a commonly employed tugboat/barge combination would take a minimum 21.5 hours to make the round trip. It is likely that more time would be required as the average towing speed would decline due to the increased probability of encountering unsuitable weather and higher waves.

The unit transportation costs would be higher than 6.2¢/cubic yard/mile because of overtime costs for the crewmen and the Federal inspector. Similarly, slower average towing speeds would increase transportaton costs as more fuel would be consumed per trip because of longer round trip times. Assuming the unit transport costs rise to 7¢/cubic yard/mile after eight hours, such a trip would require transport costs of approximately $4.42/cubic yard. As a comparison, transport costs to take dredge spoil from New London to site 7 (eight miles) would be $.49/cubic yard (Dames and Moore, 1980).

Unit dredging costs would also rise because of several additional factors. First, disposal at this distance from shore would require additional capital investment in tugs and barges capable of withstanding the weather conditions and seas that are more likely to be encountered on long trips. There are few large bottom dumping barges on the east coast currently capable of making this trip. Only large, ocean going tugs could be used on such trips and these vessels are significantly more expensive than smaller, nonocean going tugs. Secondly, there are certain to be more working (hauling) days lost per year because of inclement weather than would be lost in the more protected waters of the Sound. A tug operator will want to be certain of favorable weather before venturing on such a trip, so as to avoid being caught in heavy seas 40 or 50 miles offshore and towing a barge. Thirdly, large tugs and scows may not be able to navigate in small harbors, requiring additional handling costs for material transfer from smaller equipment. Finally, the length of such hauls would make it more difficult and expensive to maintain dredge productivity by supplying additional tugs and barges. It would not be financially or logistically feasible to supply the necessary equipment to keep a dredge operating continuously with a 22 hour round trip time between the dredging site and the disposal area.

The net economic effect of disposing of dredge spoil at or near the Continental Shelf would be to at least double (and likely triple) unit dredging cost. The incidence of this impact would be particularly severe on private businesses with small, intermittent dredging requirements. They are already feeling an economic pinch with the present arrangement of three regional disposal areas. They simply could not afford dredging which required disposal far at sea. For the Corps of Engineers, the expenditures necessary to maintain the navigable waters of the Long Island Sound would rise significantly under this option. From 1968 through 1977, the average one way haul distance for Corps projects in Connecticut using open water disposal sites was 6.3 miles (Energy Resources Company, 1979). Use of a deep water site with any degree of frequency would certainly raise this average haul distance appreciably. Even limited deep water disposal of unsuitable or highly contaminated spoil would significantly increase their expenditures.

In summary, the overall economic efficiency of open water disposal depends on the transport distance between project site and selected disposal site. In the Long Island Sound area, open water disposal would be efficient from an economic standpoint in cases where a disposal site was available within reasonable proximity to the dredging so that unit transportation costs (constant up to a distance of 19 miles) would not increase and continual operation of a dredge would be possible.

In cases where the nature of the dredged material would cause fear of contamination or carry high environmental risk, it may be desirable to contain the sediment to a limited area on the sea floor. Several different methods have been suggested, including containerized ocean disposal, the use of subaqueous borrow pits and point dumping at an approved open water containment site.

Containerized ocean disposal refers to the utilization of sealed containers filled with dredged material which carries a high environmental risk. This option is very expensive, with the cost of a suitable 5,000 gallon steel container estimated at approximately $14,000 (Shea, 1977). Using current technology, the cost of disposing of 10 million cubic yards of material by this method would be $5.6 billion or $560 per cubic yard, obviously not feasible from an economic perspective.

The utilization of subaqueous borrow pits, either natural or manmade, irregularly shaped, shallow sloped depressions in the sea floor, is generally a more feasible means of containing dredged material to a given area. Dredge material is dropped into the pit and confined by its slopes, and in some cases capped with cleaner material. The cost of this method varies significantly depending on transport distance, necessity of capping, and whether or not the pit must be created. In some cases, the high cost of this alternative could be offset by use of sands removed from the sea bottom for beach nourishment, if this could be accomplished in an economically efficient manner.

Point disposal involves the use of precision navigation techniques to position a buoy at an open water containment site, i.e. a low energy area where sediments generally accumulate and deposits form stable features on the bottom. Cost factors for this alternative vary with transport distance and the need for covering. Additional methods of open water disposal include river and harbor disposal, aquatic habitat development, and island habitat development. River and Harbor Disposal, where feasible from an environmental standpoint, would generally be the least costly method of open water disposal because the bottom material would be dumped in waters in very close proximity to the dredging site. Although the use of a hydraulic dredge to cast the material directly into nearby water would be the most economically efficient means of accomplishing the project in a minimal amount of time, this technique may be highly unlikely due to the unacceptable public response due to effects such as turbidity. A cost disadvantage over time may develop in cases where material disposed of in the river or harbor dredged found its way back into the area from which it was removed, increasing future maintenance costs. In the Long Island Sound area, river and harbor disposal would prove most economically advantageous at locations along the Connecticut River, the Thames River, the Housatonic River and the East River because of the distance that dredged material would have to be transported from the uppermost navigable reaches to a designated site in the Sound. At the present time, however, environmental conditions appear to favor the use of land disposal sites over disposal in the river for dredging projects at these locations.

Aquatic habitat development is the establishment of biological communities on dredged material at or below mean tide, such as tidal flats, seagrass meadows, oyster beds, or clam flats. This disposal method may prove to be inexpensive in cases where such habitats can be developed in water adjacent to the dredging site. Depending on the structural properties and qualities of the bottom material dredged, economic benefits may be obtainable through the propagation of exploitable shellfish or by providing a feeding ground for marketable species. More extensive research into available sites and suitability of bottom material in the Long Island Sound area is needed before any indepth economic analysis could be completed. As is the case with all other disposal methods, transport distance would be a major cost determinant in any economic feasibility study.

Island habitat development involves the creation of terrestrial communities completely surrounded by water or wetlands, generally distinguished by their isolation and limited food and cover. Since little quantifiable economic return can be estimated for the provision of roosting or nesting sites for the several sea and wading birds that would find this environment suitable, the major economic advantage to this method of disposal may prove to be comparatively low cost in relation to other alternatives when a site is available in the immediate vicinity of a dredging project. Once again, research into site availability and necessary transport distance must precede a detailed economic analysis of this disposal alternative in the Long Island Sound area.

Upland Disposal. The second major group of disposal methods under consideration is upland disposal, including marsh development, upland habitat development, confined upland disposal, wetlands disposal, land improvement, and sanitary landfill utilization. As in the case of many aquatic disposal methods, several of these disposal options share common economic characteristics.

Transportation costs are again the major variables to consider in the determination of whether an upland disposal option at a specific site is economically feasible. Five modes of transport are possible to inland disposal sites, including rail haul, barge movement, truck haul, belt conveyor movement, and, in cases where the material is a slurry, pipeline transport. Combinations of two or more of these transport methods may prove necessary, though generally not the most cost effective means because double handling always adds significantly to costs. Again, costs of transport increase as distance between the disposal site and actual dredging operation increases.

Other capital costs incurred in the implementation of all upland disposal methods include equipment, land, and access roads necessary to reach sites, each of which are site specific. In many cases, continuous operation and maintenance costs will also result to insure that a site remains attractive and productive. The labor cost component is also site specific, and varies among alternative methods.

The economic effects of marsh development and wetlands disposal are very similar in nature. Marshes and other wetlands are increasingly recognized as exceptionally valuable natural resources because of their productivity and significance in the overall food chain.

Marsh development involves the replacement of one habitat with another, and often involves a trade-off of gains and losses. In general, this would be considered a fairly inexpensive disposal method, but costs would vary according to the physical terrain because the site must be altered to meet specific elevations in relation to sea level. Additional costs would be involved in planting of grasses or other wetland vegetation and any continuing maintenance required to sustain them. If properly developed, little maintenance should be necessary, and may not be the responsibility of the Federal Government.

Wetland disposal would involve hydraulic pumping of dredged material to the site and spreading it over existing wetlands. This method of disposal would be suitable only for very small quantities of clean dredged material because of the risk involved to the existing habitat.

It is difficult to discuss whether marsh development and wetlands disposal are either cost effective or economically justified because neither option lends itself to an assessment of benefits in monetary terms alone. In areas where marshes and wetlands are diminishing, creation or enhancement of these areas through planting or disposal is of particularly significant environmental value. Thus, a determination as to whether or not these are efficient methods of disposal is possible only through a trade-off analysis between environmental quality gains and dollar costs incurred, conducted in the context of other available disposal options.

In general, when a potential site for marsh development or wetland disposal is located in close proximity to the dredging site, economic efficiency is enhanced by the possibility of utilizing a hydraulic dredge with pipeline transport. Although many of the rivers and harbors in the Long Island Sound area which will be locations of future dredging operations do have adjacent or nearby wetland areas, their suitability for disposal must be subjected to intense scrutiny for possible environmental impacts.

Marsh creation and wetland disposal have been utilized on numerous occasions throughout the United States, including the creation of a lush marshland covered with favorable vegetation at Slaughter Creek, Maryland in 1974. Available data shows that 20,000 cubic yards of material was transported up to 3/4 mile to develop a 4-acre area. Total costs rose to $102,000, of which only $75,472 were allotted for the actual dredging and disposal operation. Thus, total cost of disposal per cubic yard was $3.77, with additional costs for grooming of the terrain and plantings incurred subsequently. Costs could be significantly greater if some type of structure was necessary to contain the dredged material.

Upland habitat disposal, the development of a wide variety of terrestrial communities ranging from grasslands to dense forest to provide a habitat for various forms of wildlife in the vicinity of Long Island Sound, must also be subjected to an economic analysis similar to that described in relation to Marsh Development and Wetlands disposal. Specific costs involve transporting the material and spreading it to desired contours over the disposal site, sometimes followed by liming, fertilizing, seeding, mowing, and continued operation and maintenance, not all of which would be borne by the Federal Government. In some cases, depending on the eventual use of the habitat developed, some monetary gains could be realized. If the area developed was utilized for residential purposes, which is highly unlikely in the Long Island Sound area, or for commercial and industrial use, a dollar gain in property value may result, directly related to the disposal operation. In areas where a park would be created, recreational benefits quantifiable in dollar terms may also be calculated.

Another subcategory of upland disposal under consideration is confined upland disposal, conducted in such a manner that dredged material, particularly when considered to be an environmental risk, is confined within a limited area, minimizing environmental harm. Dredged material is pumped into the confines of a diked inland containment area, sometimes surrounded by impermeable barriers constructed at significant cost.

Disposal costs vary so widely for this method that it is very difficult to establish any average unit cost. Major variables in cost determination include, as in all disposal methods, distance and type of transport required, as well as the nature and extent of confinement structures required. These additional costs may be offset, however, in cases where the land created would be usable for commercial, industrial, recreational, or residential use. These potential benefits would depend largely upon physical characteristics of the material, as well as social and institutional acceptance of development. Although these types of benefits have resulted in many areas throughout the country, much of the material dredged from harbors and rivers in the Long Island Sound area may may not be suitable for residential or recreational development or to support structures. (This potential problem will be further discussed in the section of this appendix entitled "Aquatic containment.") It should also be noted that any development subsequent to placement of dredged material is beyond the realm of Corps of Engineers planning.

Land improvement through the use of dredged material is another upland disposal option which must be evaluated. Also referred to as landscape reclamation, this option would restore or improve land values through the unconfined disposal of dredged material, or through the filling of abandoned mines or quarries. The cost of this option would vary significantly according to disposal site, but would most likely be somewhat more expensive than other available options because available sites would require transport of material over long distances, probably by truck. An actual survey of potential sites, beyond the scope of this appendix, would have to be conducted before actual costing of this alternative could be completed. The benefits accruable to this disposal method would depend on the suitability of the material for subsequent uses, as in the case of several other methods, but the limited number of potential sites within a reasonable distance from the dredging sites along Long Island Sound would indicate that this option does not offer a high degree of potential as an economically feasible disposal method on a wide scale.

Utilization of dredged material for sanitary landfill cover is another frequently cited potential disposal option. Suitable material for this purpose is in great demand throughout the study area because of the large volume of material necessary to provide a capping of approximately six inches over each dumping of solid waste. Material suited to this purpose must have a low permeability to prevent leachate problems, and a low concentration of organic contaminants. Bottom material at many Long Island Sound ports has a high concentration of both sand, which is quite permeable, and organic materials, and therefore may not be suitable for use in its condition immediately after dredging. However, bottom material can be treated through mixture with appropriate soils to make it suitable for sanitary landfill cover, or through incineration to eliminate organic materials. Although cost of these treatments is often significant, it can be partially offset through the sale of the product because of its scarce supply and high demand. Mixture with other soils may be economically feasible in some cases, but would only be determined through a comparison with the cost of purchasing other cover materials. Incineration, which is actually an option in its own right because it may substantially reduce the volume of dredged material, requires an initial capital investment of approximately $6 million for the physical plant required and substantial operating costs thereafter, according to studies on the subject completed for the U.S. Environmental Protection Agency in 1975 and 1977. For this reason, incineration is not considered an economically feasible option in itself, nor in combination with sanitary landfill disposal.

A final upland disposal method that merits consideration is use of the material as a construction material or fill. Clean sands have a ready market in the study area at the present time, and values are expected to increase as supply becomes more scarce. Specific uses include commercial grade landfill, coarse material used as a base in road construction, and manufacture of cement, asphalt, and bricks. Obviously, each of these uses would result in some degree of economic return. Once again, however, the economic feasibility is questionable because the bottom material dredged from the Long Island Sound area is not often suitable for these uses without some form of treatment. Thus, until the price of alternative sources rises significantly due to scarcity, cost advantages would not favor extensive use of dredged material as a construction material in the study area.

In general, many of the upland disposal methods assessed would require larger expenditures than alternative aquatic disposal methods. Under most circumstances, marsh development, wetlands disposal, and upland habitat development would incur comparable levels of cost, with confined upland disposal and land improvement disposal comparable at a higher level of cost, and sanitary landfill and utilization for construction material slightly more costly due to required treatment. These generalizations would be extremely difficult to rely on, however, because of the possibility of unusually long transport distances to reach designated disposal sites in Long Island Sound.

Aquatic Containment - Like all other alternatives previously discussed, the economic impacts of aquatic containment vary significantly from site to site depending on the physical characteristics of the material.

Aquatic containment as described in the context of this report will refer to the containment of dredged material in structures designed to prevent leachate problems. These structures are of two major categories, shoreline extension and island creation. In general, both types of containment structures may be considered expensive, but in some cases the costs can be offset through the creation of usable land for industrial, residential, commercial, recreational, or fish and wildlife purposes.

The major cost components of a facility would be associated with dike construction. Costs would generally vary with the type of construction material used, location and size of the facility, and the subsurface foundation conditions. Two basic construction materials have been considered: rock and sheet-pile cofferdams. Rock structures are more feasible than the latter because of the higher construction and maintenance costs associated with sheet-pile facilities. Coarser dredged material also may be used as a "core" of the dike structure and would be faced with riprap. Shoreline extension facilities are less costly than island structures because of the greater construction costs associated with constructing offshore on a cost per cubic yard of storage volume. The cost of construction per cubic yard of disposal area generally decreases as the size of the facility increases. Based on current information facilities in Long Island Sound region would probably range from 100,000-1,000,000 cubic yards in capacity. However, larger facilities with capacities up to 10,000,000 cubic yards are also being considered. The nature of the subsurface conditions can also effect project cost. Subsurface conditions govern the design of the dike cross-section. A low bearing capacity (i.e. a soft substrate) would necessitate widening of the dike cross-section and therefore increase its volume and cost of construction.

Alternative strategies for implementation of containment structures as a solution to the disposal problem in the Long Island Sound area have been suggested. For example, the efficiency of a few larger regional facilities to receive regionally derived dredged materials would be compared with that of smaller more numerous facilities. An advantage to the latter strategy would be the ability for each structural design to be tailored to the subsequent use most economically advantageous to the surrounding area.

Many containment facilities have been successfully constructed throughout the country. The major consideration in the case of Long Island Sound, however, is whether the physical properties of the dredged material would render it suitable for any beneficial use. Prior studies of these characteristics, including grain size, water content, level of contamination, soil type, and rate of sedimentation, conducted throughout Long Island Sound have indicated that many available materials may not be well suited to support future structural development. Connecticut harbors in particular are likely to contain relatively high percentages of fine grained silts and clays which generally exhibit poor to very poor foundation properties. Thus, in consideration of economic benefits which may be accrued through the selection of aquatic containment as a disposal option, the containment areas developed may be of little structural value. However, the material can be used for potential development of aquatic, wetland, or upland habitats which could incur significant environmental benefits. This is currently being studied in detail by the Corps.

Assuming transportation costs of other alternatives are minor, the expense that would be necessary to implement aquatic containment as a disposal option, and the potentially negligible economic return on the land created do not appear to make this alternative the most efficient means of disposal from a strictly economic viewpoint. Each project would have to be evaluated on a site-specific basis. However, the choice to utilize this option may become more attractive when weighed against the costs of other disposal alternatives as well as potential benefits such as habitat development.

Beach Nourishment - A final alternative disposal method to be discussed is the utilization of material to enhance or create beach areas. Where acceptable sands are available through the dredging of bottom material, economic benefits may be realized through increased use for recreational purposes. Costs of this type of disposal are comparatively small unless stabilizing structures, such as groins or bulkheads, are necessary. Hydraulic dredging with pipeline transport can be utilized efficiently over short distances for this purpose.

Since there is a great demand for beach space along Long Island Sound and for the suitable sands to develop it, beach nourishment could be considered economically feasible and desirable in any case where clean sand is available, transport distances reasonable, and need for stabilizing structures minimal.

VI. SUMMARY

The economic impacts of various alternative methods of dredged material disposal are difficult to assess due to the fact that alternatives under consideration are not site-specific at the present time. Major variables in an analysis of cost efficiency of disposal methods include travel distance from dredging site to disposal site, whether it be by truck, rail, or barge; quantity of material to be dredged; dredging method to be used; and physical characteristics of the dredged material which determine its suitability for productive utilization with an economic return. Each of these variables is specific to individual dredging and disposal sites, and could readily be subjected to detailed analysis upon identification of both sites. In the context of this appendix, however, the level of detail in the economic analysis is limited by the general terms in which the alternatives are defined and discussed.

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